Faculty Working Papers

THE MARKET MODEL: POTENTIAL FOR ERROR

Dennis J. Collins, Assistant Professor
Department of Accountancy
James C. McKeown, Professor, Department of Accountancy

#606

College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

Faculty Working Papers

INDUSTRY CLASSIFICATION, BUSINESS RISK AND OPTIMAL FINANCIAL STRUCTURE

J. Kenton Zumwalt, Assistant Professor, Department of Finance
Tai S. Shin, Virginia Commonwealth University

#613

College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

FACULTY WORKING PAPERS

College of Commerce and Business Administration

University of Illinois at Urbana-Champaign

October 8, 1979

INDUSTRY CLASSIFICATION, BUSINESS RISK AND OPTIMAL FINANCIAL STRUCTURE

J. Kenton Zumwalt, Assistant Professor, Department of Finance
Tai S. Shin, Virginia Commonwealth University

#613

Summary:

This study examines the relationships among financial leverage, industry classification and business risk. The results show that some industries exhibit different financial structures but that many industries do not exhibit dissimilar financial structures. The results also indicate there is little relationship between industry classification and business risk measures. Finally, little associations were found between financial structure and business risk.

Industry Classification, Business Risk
and Optimal Financial Structure

Finance theory indicates that an optimal financial structure should exist in a world where interest payments are a tax deductible expense and market imperfections limit the amount of fixed-income obligations a firm can issue [4]. The optimal level of debt occurs at the point where the marginal benefit of the tax shield due to additional borrowing is exactly offset by the expected marginal cost of financial distress [5]. The probability of financial distress is a function of both the distribution of operating income and the level of contractual debt obligations. Firms with high and relatively certain levels of operating income are able to support larger debt obligations than those firms with lower and/or less certain levels of operating income.

The optimal financial structure should be related to the business risk faced by the firm. That is, those firms facing high business risk should opt for low financial risk, and vice versa. In recent years several studies have examined the relationship between industry classification and the financial structure of the firm [1,2,3,9,10,11,12,14]. These studies, which assumed industry classification as an adequate proxy for business risk, attempted to determine if firms in different industry classifications exhibit similar financial structures. Of these studies several suggest industry classification is a determinant of financial structure [10,11,12] while other studies suggest industry classification is not related to financial structure [1,9,14].

This paper has two objectives; (1) to shed light on the industry classification-financial structure disagreement and (2) to suggest a more appropriate method than industry classification for determining

"equivalent risk class" firms. The first objective will be achieved by performing a more in-depth analysis of the financial structure of the industries under consideration. In addition to considering debt and equity, this study breaks the total debt into current liabilities and long-term debt. Also, preferred stock is separately analyzed. The second objective of developing equivalent risk classes is achieved by utilizing a cluster analysis procedure to group firms according to a measure of business risk.

Business Risk and Industry Classification

Modigliani and Miller [6] introduced the concept of "equivalent return classes" and suggested these "homogeneous" groups were analogous to industry classifications. The groups were assumed to be homogeneous with respect to the uncertainty attaching to expected operating income, or business risk of the firm. Subsequent to the M & M studies many, if not most, of the studies concerning financial leverage and/or dividend policy assumed industry classification to be an adequate proxy for equivalent business risk.

Business risk, defined as the uncertainty inherent future operating income, is a function of the uncertainty of future sales and the operating leverage utilized by the firm. The products and/or services produced by the firm determine not only the firm's industry classification, but also, to a great extent, the sales potential and the operating leverage of the firm. A firm's operating leverage is determined by the extent of fixed costs associated with its total cost structure. Firms with a high proportion of fixed costs exhibit high operating leverage.

Firms will exhibit varying degrees of business risk due to differing uncertainties regarding sales and/or differing use of operating leverage. The demand for the firm's products influences the uncertainty of sales while the asset structure and efficiency of asset utilization influences the firm's operating leverage. For example, two firms with similar operating leverage can exhibit different degrees of business risk if one firm is much less certain of its expected sales than the other firm. Alternatively, two firms facing similar sales potential will exhibit different degrees of business risk if one firm is more highly levered operationally than the other.

Firms producing different products may have different asset structures resulting in different levels of operating leverage. Also, the type of product or service may influence the minimum size of the firm and the sales potential for the firm. For example, firms in the steel industry are more capital intensive, have a larger minimum size, and exhibit greater sales variability than firms in the food industry. This line of reasoning supports the view that industry classifications may be an adequate proxy for business risk. However, in order for industry classification to be an adequate proxy, it must also be assumed that (1) all firms in the same industry face reasonably similar demand for their products, (2) the technology of the industry requires all firms to have similar type assets, and (3) all firms are reasonably similar in the efficiency of asset utilization. Presumably, if these assumptions hold all firms in the industry will exhibit similar business risk.

Now, assuming optimal financial structures are related to business risk, and assuming firms in a particular industry have similar business risk, then it can be assumed that industries facing different business risk will exhibit different financial structures.

In the real world, however, it is unlikely that these assumptions are met. In any industry many factors exist which may cause differences among the business risk characteristics of the firms. For example, due to product differentiation the demand for two similar products may be different (i.e., name brand vs. generic drugs). Also, different size firms may utilize different operating leverage in that the larger firms may use more capital intensive processes. The cost structure for firms may vary due to different ages of the equipment used. Even if all firms in the same industry face similar business risk, differences in managements risk-taking preferences can cause the financial structure to be nonhomogeneous within the industry.

Business Risk and Optimal Financial Structure

In a world with taxes and no bankruptcy costs, M & M [7] have shown that the value of the firm is

$$V = \frac{X(1-T)}{k_e} + \frac{Tk_D D}{k_D} , \qquad (1)$$

where X is the expected (perpetual) before-tax operating cash flow, T is the firm's tax rate, D is the market value of the firm's debt, and k_e and k_D are the capitalization rates for the cash flows of an unlevered firm and for the interest payments on debt, respectively.

Ignoring the problem of possible insolvency with associated bankruptcy costs allows the firm to continue to increase its value by issuing more and more debt. In the "real world," however, lenders will not allow a firm to borrow without limit. As financial leverage is increased, the probability of insolvency increases as do any costs associated with possible bankruptcy.

Hong and Rappaport [5] defined insolvency as a state in which a firm's operating cash flows are inadequate to meet contractual debt obligations and noted that bankruptcy will follow if the firm is unable to meet its obligations. Denoting the cost of this "financial distress" as insolvency cost, H & R modify valuation equation (1) by adding a term for insolvency cost.

$$V = \frac{X(1-T)}{k_e} + TD - k_I D \tag{2}$$

where k_I is the cost of insolvency per unit of debt. Now, as debt is increased the value of the firm is increased by the value of the tax benefits of the interest payments and decreased by the cost of insolvency, $k_I D$. The optimal capital structure occurs at the point where the marginal tax benefit of additional debt is equal to the marginal insolvency cost of additional debt.

Hong and Rappaport assume the insolvency cost, k_I, is an increasing function of financial leverage given the annual operating cash flow distribution. That is

$$k_I = f(D\ X, \sigma), \tag{3}$$

where X and σ are mean and standard deviation of the cash flows. Insolvency costs defined in this manner must consider both the cost

of bankruptcy and the probability of bankruptcy actually occurring. However, if the business risk is allowed to vary across firms, bankruptcy costs are a function of the operating cash flows as well as the level of debt utilized in the firm's financial structure. Now, bankruptcy costs, b, may be defined

$$b = f(D,X,\sigma). \tag{4}$$

This formulation indicates the probability of bankruptcy costs actually being incurred are a function of the level of debt obligations and the level and certainty of the operating cash flows. Since greater operating cash flows allow the firm to take on a greater debt burden, b is a decreasing function of X. However, as in the H & R formulation, b is an increasing function of debt. Also the probability of bankruptcy costs occurring increase as the uncertainty of the operating cash flows, σ, increases.

In addition to changing the probability of bankruptcy costs, allowing the cash flow distribution to vary across firms will result in different capitalization rates across firms.

Review of Previous Studies

Several studies have investigated the assumption that financial structure is related to industry classification. Wippern [14] regressed the logarithms of operating earnings against time for a ten-year period. He used the standard error of the regression as a proxy for business risk. He examined 61 firms in 8 industries, and concluded that industry classifications do not discriminate among groups of firms with equivalent business risk. However, Schwartz and Aronson [10] used a common equity-to-total asset ratio to describe the financial structure of 32

firms in 4 industries. They concluded industries do exhibit significantly different financial structures. Gonedes' study [3] had two conclusions; (1) firms in a particular industry do not exhibit similar degrees of business risk and (2) significant differences in business risk between industries do exist. Gonedes used a relative growth rate measure as the business risk proxy.

Four studies [1,9,11,12], two of which indicate industry classification _is_ a determinant of financial structure and two of which indicates it is _not_, utilized similar methods of analysis. In these studies a variable designed to reflect the financial structure of the firm was calculated and an analysis of variance procedure was utilized. (Scott and Martin also used the Kruskal-Wallis one-way analysis of variance by rank.) The Scott, and the Scott and Martin studies used common equity-to-total assets as the financial structure variable while Belkaoui used total debt-to-total equity and Remmers, Stonehill, Wright and Beekhuisen (RSWB) used total debt-tototal assets. The number of firms, industries and years examined vary among the studies.

Most recently Ferri and Jones [2] employed a cluster analysis procedure to partition firms into 6 distinct classes based on a total debt-to-total asset ratio. A cross-tabulation of financial leverage classes with industry classification showed only a "slight statistical relationship between relative debt structure class and generic industry class." [2, p. 638] Ferri and Jones also reported that a firm's leverage and income variation could not be shown to be associated. All these studies are summarized in Table 1.

A Summary o

Study	# of Industries	# of Firms	Years	Va
1. Ferri & Jones (1979)	10	233	1969-1976	Total Debt/
2. Scott & Martin (1975)	12	159 to 277	1967-1972	Common Equi
3. Belkaoui (1975)	13	155	1968-1973	Total Debt/
4. Remmers, Stonehill, Wright & Beekhuisen (1974)	9	258 to 328	1966, 1970, 1971	Total Debt/
5. Scott (1972)	12	77	1959-1968	Common Equi
6. Gonedes (1969)	8	80	1958-1967	Deviations of Growt Income f pound Rat
7. Schwartz & Aronson (1967)	4	32	1928, 1961	Common Equi
8. Wippern (1966)	8	61	1954-1963	Antilog of Error ar arithmic Annual Ea 1954-196

Methods of Analysis

Seven variables describing financial structure and interest obligations and eight measures of business risk were utilized. A parametric analysis of variance and a Kruskal-Wallis one-way analysis of variance procedures were utilized to determine if there were industry differences with respect to financial structure and business risk. The Kruskal-Wallis procedure utilizes rank-ordered data. Next, product-moment and rank-order correlation procedures were utilized to examine the association between the financial structure measure and the business risk measures. Also, the relationship among the business risk measures were examined. Finally, a cluster analysis procedure was used to partition the firms into groups based on business risk measures. The ANOVA procedure was employed to determine if firms in different business risk classes exhibited different financial structures.

The Sample

The firms used in this study were selected to duplicate as nearly as possible those of the Scott and Martin study with two additional constraints; data for each firm had to be available for the entire period and only firms with December fiscal years were considered. These requirements resulted in 198 firms representing 11 industries being examined each year. The common fiscal year requirement should make the firms more homogeneous, as the levels of debt may vary over the year for those firms with highly seasonal sales. Data from the 1966-1976 period were utilized. The data were examined for two five-year periods and for the entire ten-year period. The industry classification numbers and the number of firms in each industry are presented in Table A-1 in the appendix.

The Variables

The seven financial structure and eight business risk measures utilized in this study are listed in Table 2. Five of the financial structure variables indicate the proportion of total assets provided by each liability and equity account. The other two financial structure measures are concerned with the interest payments associated with the financial structure. For example, variable seven is the inverse of the familiar interest coverage ratio and indicates the extent to which a firm is able to cover its interest obligations. Variable eight is an average rate of interest over all debt, both short and long term. Depending on the leverage measure used, it is possible that a firm could be highly levered but actually have a relatively low interest obligation. For example, a firm could have a high TD/TA ratio but because much of the total debt is non-interest current liabilities, the firm could have a low interest payment obligation.

Business risk measures are designed to indicate the uncertainty of future income. Four variables, the standard deviations of the standardized sales growth and standardized growth in earnings before interest and taxes and the coefficients of variation of sales and EBIT, are similar to those used by Ferri and Jones.[1] The other four variables are similar to the variable used by Wippern; that is, the anti-log of the standard error of the estimate around the logarithmic regression of sales and EBIT over the 1966-1976 period (ASEE Sales and ASEE EBIT) and these same variables relative to the mean of sales and of EBIT.

---

[1]The standardized growth variables were calculated as $\sigma_{SG} = \sigma[(S_t - S_{t-1})/\bar{S}]$ where $t = 1,2,\ldots,10$. This procedure adjusts the measure for differences in size among the firms. See [2, p. 633].

Table 2

Financial Structure and Business Risk Measures

Financial Structure Variables	Business Risk Variables
1. $\frac{\text{Current Liabilities}}{\text{Total Assets}}$	1. Standard Deviation of Sales Growth: σ_{SG}
2. $\frac{\text{Long-Term Debt}}{\text{Total Assets}}$	2. Coefficient of Variation of Sales: γ_{Sales}
3. $\frac{\text{Total Debt}}{\text{Total Assets}}$	3. Anti-Log of the Standard Error of the Estimate of Sales (ASEE Sales)
4. $\frac{\text{Preferred Stock}}{\text{Total Assets}}$	4. $\frac{\text{ASEE Sales}}{\text{Mean Sales}}$
5. $\frac{\text{Common Equity}}{\text{Total Assets}}$	5. Standard Deviation of EBIT Growth: σ_{EG}
6. $\frac{\text{Interest}}{\text{Earnings Before Interest and Taxes}}$	6. Coefficient of Variation of EBIT: γ_{EBIT}
7. $\frac{\text{Interest}}{\text{Total Debt}}$	7. Anti-Log of the Standard Error of the Estimate of EBIT (ASEE EBIT)
	8. $\frac{\text{ASEE EBIT}}{\text{Mean EBIT}}$

The variables listed as financial structure measures were calculated as five-year averages for the 1966-1971 and 1971-1976 periods and as a ten-year average for the entire 1966-1976 period. Because the business risk measures involve standard deviations and standard errors of estimates of regressions, the entire ten-year period was used in their calculation.

EMPIRICAL RESULTS

Financial Structure Measures

Table 3 presents the ANOVA results for both the financial structure measure and the business risk measure. The financial structure variables which are a proportion of total assets are very consistent for both subperiods and the entire 10-year period. All of these variables except preferred stock/total assets showed significant differences existed among the industry means. Similar results occurred when the variables were rank ordered. Results of the Kruskal-Wallis one-way analysis of variance by rank are presented for the 10-year period only and are denoted by "RO". These results support those reported by Scott and Scott and Martin.

Of the interest obligation related variables interest/total debt exhibited a significant F-ratio for the first subperiod while interest/EBIT was significant only when the data were rank ordered. This suggests that while differences exist from a financial structure standpoint, interest obligations relative to EBIT and total debt are not significantly different among industries.

While the variables utilized by Scott, and Scott and Martin (CE/TA) and by Belkaoui (TD/TA) both indicate significant differences exist among industries, the ANOVA does not indicate which industries or how

Table 3

Summary of ANOVA Results for Eleven Industries: Five and Ten Averages
1967 - 1976

F-RATIOS

Financial Structure Variables	1967-1971	1972-1976	1967-1976	1967-1976RO†	Business Risk Variables	1967-1976	1967-1976RO
1. Current Liabilities / Total Assets	8.280**	10.175**	10.826**	74.875**	1. Standard Deviation of Sales Growth	5.443**	74.544**
2. Long Term Debt / Total Assets	5.075**	4.313**	5.131**	40.731**	2. Coefficient of Variation of Sales	8.563**	40.855**
3. Total Debt / Total Assets	5.097**	5.975**	6.035**	45.518**	3. Anti-Log of the SEE of Sales	1.760	66.193**
4. Preferred Stock / Total Assets	0.838	1.439	1.106	11.902	4. Anti-Log SEE Sales / Mean Sales	0.845	70.043**
5. Common Equity / Total Assets	2.204*	2.610**	2.408*	22.720*	5. Standard Deviation of EBIT Growth	1.315	76.562**
Interest Related Variables					6. Coefficient of Variation of EBIT	1.246	65.950**
6. Interest / EBIT	0.793	1.029	0.980	37.158**	7. Anti-Log of the SEE of EBIT	2.388*	42.032**
7. Interest / Total Debt	3.438**	1.282	1.755	21.313*	8. Anti-Log SEE EBIT / Mean EBIT	0.459	79.794**

*Denotes significance at the .05 level.
**Denotes significance at the .01 level.
†These values are H statistics from the Kruskal-Wallis One-Way Analysis of Variance by ranks. See Siegel [13], p. 185.

many industries are significantly different. For this reason, the Scheffe multiple comparisons test was performed to determine which industries were responsible for the significant differences. These results are presented in Table 4. As can be seen, the CE/TA measure indicates only two significant differences exist; the metal mining industry's CE/TA ratio is significantly different from ratios of the Forest-Paper Products industry and from the Chemical industry. The total debt/total assets ratio indicates seven significant differences exist; metal mining is significantly different from the forest-paper, steel works, smelting, machine tool, auto parts and retail stores. Also, the drug industry TD/TA ratio is significantly different from the retail store industry. This example shows that the variable used in the study can contribute to different conclusions.

In summary, an analysis of variance procedure suggests differences exist among the financial structures of different industries but that the measures used in the testing may contribute to alternative conclusions. The industries, variables and time period used in this study support the work of Scott and Scott and Martin.

Business Risk Measures

The business risk measures were calculated using the entire ten-year period.[2] The ANOVA procedure was again used to test for significant differences and the results are shown in Table 3. Three of the

---

[2]While the authors are not comfortable with only ten observations for the business risk calculations, the ten observations are more than those used by Wippern (8 years) and by Ferri and Jones (two five year periods).

Table 4

Results of the Scheffe Multiple Comparison Tests

Differences in CE/TA and TD/TA Means†
(1967-1976)

Industry Number	Industry	2	3	4	5	6	7	8	9	10	11
1	Metal Mining	3.53 (-2.96)	4.60* (-4.39)*	4.67* (-3.67)	2.94 (-2.04)	3.93 (-3.28)	1.62 (-4.40)*	4.39 (-5.21)*	4.07 (-4.91)*	4.00 (-4.36)*	4.13 (-6.18)*
2	Oil		.63 (-1.84)	.21 (-.29)	-.85 (1.10)	.51 (-.55)	-.91 (-1.09)	1.02 (-1.97)	.08 (-1.56)	.01 (-1.05)	.89 (-3.47)
3	Forest/ Paper			-.54 (.91)	-1.62 (2.38)	-.06 (.40)	-1.42 (-.01)	.50 (-.99)	-.62 (-.52)	-.70 (.03)	.37 (-2.72)
4	Chemicals				-1.28 (1.57)	.40 (-.34)	-1.15 (-.92)	.98 (-1.90)	-.14 (-1.45)	-.23 (-.87)	.83 (-3.50)
5	Drugs					1.36 (-1.59)	-.31 (-2.38)	1.89 (-3.28)	1.04 (-2.90)	.96 (-2.34)	1.71 (-4.61)*
6	Glass						-1.29 (-.41)	.50 (-1.24)	-.48 (-.84)	-.54 (-.38)	.38 (-2.77)
7	Steel Works							1.68 (-.99)	1.02 (-.51)	.96 (.04)	1.57 (-2.72)
8	Smelting								-1.03 (.50)	-1.09 (1.03)	-1.02 (-1.86)
9	Machine Tools									-.08 (.55)	.88 (-2.32)
10	Auto Parts										2.11 (-2.75)

†TD/TA comparison values are within the parentheses.

*Denotes significant difference at the .05 level.

measures, the standard deviation of sales growth, the coefficient of variation of sales, and anti-log of the standard error of the estimate around the logarithmic regression of EBIT over time, showed that significant differences existed among industries. When the same data were ordered by rank and used in the Kruskal-Wallis procedure, all measures exhibited high levels of significance. These results suggest several possibilities. One possibility is that absolute measures of business risk, i.e., without ordering, may not adequately explain the differences among industries due to the possibility of extreme values causing high standard deviations and, hence, large amounts of group overlap. A second possibility is that these measures do not adequately reflect business risk. If the business risk measures are appropriate then it appears that the industries' financial structures have evolved without explicit consideration of business risk. This suggests that previous studies using industry classification as a proxy for business risk have not utilized firms of similar business risk. The rank order procedure shows the relative position of the firm's business risk measure.

The Relationships Among Business Risk Measures

Product moment and rank order correlations between the eight measures of business risk were next examined and the results are presented in Table 5. Of the 56 correlation coefficients (28 product moment and 28 rank order) there are 36 significant (11 product moment and 25 rank order) at the .05 level. This finding supports the possibility that extreme values for the non-rank ordered data may have caused the finding that few business risk measures are related to industry classification as reported in Table 3. Eleven of the 28 comparisons show both the product moment and the rank order correlation

Table 5

Product Moment and Rank Order Correlations Between
Alternative Measures of Business Risk[†]

1966-1976

	σ_{SG}	γ_{Sales}	A-SEE$_{Sales}$	$\frac{\text{A-LogSEEs}}{\text{Mean Sales}}$	σ_{EG}	γ_{EBIT}	A-SEE$_E$
2. γ_{Sales}	.557** (.360)**						
3. Antilog SEE of Sales	.306** (.775)**	.182** (.292)**					
4. $\frac{\text{Antilog SEE Sales}}{\text{Mean Sales}}$	.259** (.760)**	.202** (.265)**	.166** (.958)**				
5. σEBIT Growth	.176* (.626)**	-.010 (-.101)	.024 (.566)**	.031 (.560)**			
6. γEBIT	-.027 (.552)**	.024 (.165)*	.023 (.565)**	.031 (.578)**	-.874** (.724)**		
7. Antilog SEE EBIT	-.031 (.641)**	-.102 (-.109)	.009 (.657)**	-.014 (.660)**	.310** (.883)**	-.193** (.710)**	
8. $\frac{\text{Antilog SEE EBIT}}{\text{Mean EBIT}}$	.128 (.282)**	.011 (-.108)	-.034 (.242)**	-.005 (.249)**	-.054 (.374)**	-.020 (.198)**	-.366** (.470)**

[†]The rank ordered correlations are within the parentheses.
*Denotes significance at the .05 level.
**Denotes significance at the .01 level.

are significant. The standard deviation of sales growth was the variable with the most significant product moment correlations being related to four other variables.

Four business risk measures showed significant rank order correlations with all seven other measures. These four are the standard deviation of sales growth (σ_{SG}), the antilog of the standard error of the estimate of sales (ASEE Sales), ASEE Sales/mean sales, and the coefficient of variation of EBIT. Both the sales variables and the EBIT variables exhibited substantial intragroup associations (12 of 12 and 10 of 12) and less intergroup associations (14 of 32).

Relationships Between Financial Structure and Business Risk Measures

Product moment and rank order correlations between the financial structure and business risk measures are presented in Table 6. As can be seen the business risk measures utilizing EBIT are more often related to the financial structure variables than are the business risk measures which utilize sales. The (ASEE Sales/mean sales) was related to three of the financial structure ratios and the interest coverage variable. Three of the four of the EBIT risk measures were related to three of the financial structure ratios and both interest payment measures. This suggests the level and uncertainty of EBIT may be more crucial to financial structure than the level and uncertainty of sales. Of the 33 significant relationships, 18 are due to the rank order correlation. While these results indicate business risk is related to financial structure, the previous results concerning industry classification show that industries are not homogeneous with respect to business risk.

Table 6

Product Moment and Rank Order Correlations
Between Financial Leverage Measures and Business Risk Measures†

Financial Leverage Variables	Business Risk Measures							
	σ_{SG}	γ_{Sales}	A-SEE$_S$	A-SEE$_S$ / Mean	σ_{EG}	γ_{EBIT}	A-SEE$_E$	A-SEE$_E$ / Mean
1. Current Liabilities / Total Assets	-.025 (-.141)*	-.131 (-.091)	.006 (-.130)	-.165** (-.099)	.002 (-.060)	-.006 (-.126)	-.077 (-.137)	.077 (-.042)
2. Long-Term Debt / Total Assets	.132 (.146)*	-.020 (-.037)	.029 (.041)	-.114 (.006)	.307** (.146)*	-.285**	.140*	.057
3. Total Debt / Total Assets	.093 (.077)	-.098 (-.090)	.028 (-.004)	-.196** (-.006)	.256** (.142)*	-.240** (.019)	.068 (.167)*	.095 (.188)**
4. Preferred Stock / Total Assets	-.018 (.005)	-.030 (.060)	-.051 (-.051)	-.042 (-.105)	-.032 (-.026)	.041 (-.126)	-.087 (-.065)	.042 (.058)
5. Common Equity / Total Assets	-.063 (.077)	.071 (.066)	-.010 (.004)	.190** (.020)	-.183** (-.087)	.182** (.009)	-.024 (-.113)	-.109 (-.169)*
6. Interest / EBIT	-.085 (.256)**	-.028 (-.233)**	.005 (.193)**	.009 (.164)*	-.942** (.446)**	.975** (.317)**	-.228** (.470)**	.017 (.240)**
7. Interest / Total Debt	.155 (.077)	.032 (-.090)	.083 (-.004)	.021 (-.006)	.013 (.142)*	.021 (.019)	.042 (.167)*	-.040 (.188)**

†The rank ordered correlations are within the parentheses.
*Denotes significance at the .05 level.
**Denotes significance at the .01 level.

As expected, the correlation coefficients signs are opposite for the debt and common equity ratios. For instance, the sign for the relationship between Long-Term Debt/Total Assets and γ_{EBIT} is negative while the sign between Common Equity/Total Assets and γ_{EBIT} is positive. Since the γ_{EBIT} indicates the variability of EBIT relative to the mean, the signs of the coefficient is reasonable. That is, higher variability relative to the mean is consistent with lower debt and higher equity. Other signs, however, are more difficult to explain. The ASEE EBIT measure is positively related to the debt/asset ratios indicating firms with greater EBIT uncertainty has higher debt/asset ratios.

The Interest/EBIT variable is related to all business risk measures when the data are ordered by rank. The relationship is positive for all measures except for γ_{Sales}. The positive relationship means that firms with high business risk also have high levels of interest obligations relative to EBIT. This result does not support the proposition that firms with high financial risk should have low business risk.

More work remains to be done in the measurement of business risk.

Grouping Firms by Business Risk Measures

The results of the previous section imply the firms' financial structure are more closely related to the EBIT measures than the sales measures. Theory also indicates operating income uncertainty is the relevant factor in assessing business risk. Therefore, the four business risk variables associated with EBIT were utilized in a cluster analysis procedure to group the firms according to their business risk.

Cluster analysis is a multivariate technique designed to group observations based on their similarity or proximity to the other observations. The procedure assigns objects to groups in such a manner as to minimize the differences within each group and to maximize the differences between the groups. The proximity measure used in this study was the Euclidian distance, defined as:

$$d^2 = (X_{ij} - \overline{X}_i)\ (X_{ij} - \overline{X}_i)',$$

where X_{ij} is the j^{th} observation in the i^{th} cluster and $\overline{X}_i$ is the mean of the i^{th} cluster.

The criteria used to determine the number of distinct groups existing in the data is the point at which $\delta^2\lambda/\delta g^2 = 0$; where λ = the ratio of the determinant of the within-cluster sums of squares matrix to the total sums of squares matrix,[3] and g refers to the number of groups.

The 198 firms were partitioned successively into 2,3,...,11 clusters, and the lambda criterion calculated. This procedure was followed for each of the four EBIT business risk measures. The lambda criterion indicated that there were six groups when the coefficient of variation of EBIT was examined, seven groups when the standard deviation of EBIT growth and when the ASEE EBIT measures were used, and eight groups when the (SEE EBIT)/EBIT measure was utilized. For consistency purposes, seven groups for each measure was used in further analysis.

---

[3] As noted by Ferri and Jones [2] this criteria is based on the notion that the within-group variance declines initially due to true group differences. Beyond some number of groups, however, the decline in the within-groups variance is due to partitioning of error variance and further partitioning does not indicate more groups exist in the data.

Each of the seven groups is composed of firms with similar values for the business risk measure. The ANOVA procedure was then used to test for significant differences among the financial structure variables. Significant differences would indicate that firms within a particular business risk group have, indeed, developed similar financial structures. The results of the ANOVA procedure are presented in Table 7. As can be seen, only two of the business risk measures show the existence of significantly different mean values. The σ_{EG} indicates that the means of the long-term debt/total assets ratios are significantly different while the ASEE EBIT measure shows that all of the financial structure variables, except PS/TA, are significantly different. None of the interest related measures were significantly different among the seven groups.

Conclusion

This study examined the associations between financial leverage and industry classifications, and business risk. The results support the notion that different industries exhibit financial structures. However, it should be noted that only one industry was responsible for most of the differences. This indicates that the sample of industries used in the analysis can be crucial, and suggests many industries may not exhibit dissimilarity in financial structure. The results also indicate little relationship exists between industry classification and measures of business risk when the actual values for business risk were utilized. On a rank-ordered basis, significant industry differences were strong.

Table 7

ANOVA Results of the Seven Clustered Groups

Financial Leverage Variables	F-RATIOS: Business Risk Measures σ_{EG}	γ_{EBIT}	A-SEE_e	SEE_e/MEAN
1. Current Liabilities / Total Assets	0.614	1.894	2.872*	2.124
2. Long-Term Debt / Total Assets	2.174*	1.756	2.634*	1.658
3. Total Debt / Total Assets	0.905	0.154	3.049**	1.942
4. Preferred Stock / Total Assets	0.609	1.352	1.237	0.847
5. Common Equity / Total Assets	0.358	0.285	2.587*	1.289
Interest Related Variables				
6. Interest / EBIT	1.627	1.696	2.142	1.999
7. Interest / Total Debt	2.020	1.215	0.899	0.565

*Denotes significance at the .05 level.
**Denotes significance at the .01 level.

The results of this study and the other studies of financial structure and business risk show that much more research needs to be done in the area of business risk definition and measurement.

REFERENCES

1. Ahmed Belkaoui, "A Canadian Survey of Financial Structure," Financial Management (Spring 1975), p. 74.

2. Michael G. Ferri and Wesley H. Jones, "Determinants of Financial Structure: A Methodological Approach," Journal of Finance (June 1979), pp. 631-644.

3. Nicholas J. Gonedes, "A Test of the Equivalent Risk Class Hypothesis," Journal of Financial and Quantitative Analysis (June 1969), pp. 159-177.

4. Charles W. Haley and Lawrence D. Schall, The Theory of Financial Decisions, 2nd Edition, McGraw-Hill, New York, 1979.

5. Hai Hong and Alfred Rappaport, "Debt Capacity, Optimal Capital Structure, and Capital Budgeting Analysis," Financial Management (Autumn 1978), pp. 7-11.

6. John D. Martin and David F. Scott, Jr., "Debt Capacity and the Capital Budgeting Decision," Financial Management (Summer 1976), pp. 7-14.

7. Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," The American Economic Review (June 1958), pp. 261-97.

8. Franco Modigliani and Merton H. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction," The American Economic Review, (June 1963), pp. 433-43.

9. Lee Remmers, Arthur Stonehill, Richard Wright, and Theo Beekhuisen, "Industry and Size as Debt Ratio Determinants in Manufacturing Internationally," Finance Management (Summer 1974), pp. 24-32.

10. Eli Schwartz and J. Richard Aronson, "Some Surrogate Evidence in Support of the Concept of Optimal Financial Structure," Journal of Finance (March 1967), pp. 10-18.

11. David F. Scott, Jr., "Evidence on the Importance of Financial Structure," Financial Management (Summer 1972), pp. 45-50.

12. David F. Scott, Jr. and John D. Martin, "Industry Influence on Financial Structure," Financial Management (Spring 1975), pp. 67-73.

13. Sidney Siegel, Non-parametric Statistics, McGraw-Hill, New York, 1956.

14. Ronald F. Wippern, "A Note on the Equivalent Risk Class Assumption," The Engineering Economist (Spring 1966), pp. 13-22.

Appendix A-1

Industries in Sample

Industry Class	Compustat Codes	Number of Firms
1. Metal Mining	1000, 1021, 1031	21
2. Oil-Crude Producers	1311	15
3. Forest and Paper Products	2400, 2600	20
4. Chemicals	2800, 2810, 2820	24
5. Drugs	2835, 2836, 2837	21
6. Glass Products and Containers	3210, 3221	11
7. Blast Furnaces and Steel Works	3310	20
8. Smelting and Metal-working	3330, 3341, 3350	17
9. Machine Tools	3340, 3550	20
10. Auto Parts	3714	20
11. Retail Stores	5311, 5312, 5331	9
		198

Faculty Working Papers

HUMAN INFORMATION PROCESSING FOR DECISIONS TO INVESTIGATE COST VARIANCES

Clifton Brown, Assistant Professor, Department of Accountancy

#614

College of Commerce and Business Administration
University of Illinois at Urbana-Champaign